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In Re Application Of: **Farquhar et al.**

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Serial No.	Filing Date	Examiner	Group Art Unit
09/781,730	2/12/2001	Goff II, John L.	1733

Title: **SEMICONDUCTOR DEVICE HAVING A THERMOSET-CONTAINING DIELECTRIC MATERIAL AND METHODS FOR FABRICATING THE SAME**

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Reply Brief of Appellants-11 pages

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DOCKET NO.: EN9-98-122US3

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Farquhar *et al.*

Examiner: Goff II, John L.

Serial No.: 09/781,730

Art Unit: 1733

Filed: 2/12/01

For: **SEMICONDUCTOR DEVICE HAVING A THERMOSET-CONTAINING DIELECTRIC MATERIAL AND METHODS FOR FABRICATING THE SAME**

Commissioner for Patents
P.O. Box 1450
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REPLY BRIEF OF APPELLANTS

This Reply Brief addresses issues raised in the Examiner's Answer mailed August 18, 2003.

Issue 2

CLAIMS 23, 25, 29, 32, 35, 36, 40-43, and 45 UNDER 35 U.S.C. §102(B) ARE NOT UNPATENTABLE OVER JOHNSON (US PATENT 4,747,897).

The Examiner rejected claims 23, 25, 29, 32, 35, 36, 40-43, and 45 under 35 U.S.C. §102(b) as allegedly unpatentable over Johnson (US Patent 4,747,897).

Claim 23

An issue of claim 23 is whether Johnson discloses the "remaining layer of resin" in the following first and second features of claim 23:

"processing the fluoropolymer matrix with the resin coated thereon such that material from the resin impregnates the fluoropolymer matrix, leaving **a remaining layer of resin** on a surface of the fluoropolymer matrix, wherein **the remaining layer of resin** comprises material of the resin that has not impregnated the fluoropolymer matrix"; and

"laminating the resin-impregnated fluoropolymer matrix to a conductor, wherein the conductor and **the remaining layer of resin** are disposed on opposite sides of the resin-impregnated fluoropolymer matrix following the laminating step".

The Examiner's Answer argues: "It is noted a layer of resin is present on each surface of the dielectric material (bonded or not) after lamination because if the layer were not present the circuit board would delaminate (Figure 8 and Column 8, lines 1-4)."

Appellants contend that the preceding argument by the Examiner is an admission that Johnson does not explicitly recite the "remaining layer of resin" of claim 23, and instead constitutes an allegation that Johnson inherently recites said layer of resin. In response, Appellants contend that in FIG. 8 of Johnson, the foils 32 are bonded to the composite 36 through surface bonding between the foils 32 and the composite 36. FIG. 8 shows said surface bonding and does not show a layer of resin. Accordingly because of said surface bonding, the circuit board is intact and not delaminated in FIG. 8 of Johnson, even though no layer of resin is present.

In FIG. 8 of Johnson, the surface of the composite 36 at which the bonding with the foils 32 occurs comprises a homogeneous distribution of epoxy resin around the fibers of the composite 36. Thus, the epoxy resin is present in said surface effectuates said bonding. However, the epoxy resin in FIG. 8 of Johnson is not depicted as a layer and thus does not exist in the structural form of a "layer" as required by claim 23. For support, Appellants provide the following analysis.

Appellants contend that the alleged layer of resin referred to by the Examiner allegedly on each surface of the dielectric material (as deduced by the Examiner from Johnson, FIG. 8 and cos 1-4) was generated by C-stage curing as described by Johnson, col. 7, lines 64-67. However, Johnson makes it clear that C-staged curing results in distributing the resin homogeneously within the fluoropolymer matrix. See Johnson, col. 6, lines 47-52 ("FIG. 2 shows a stack of the pre-preg sheets 30 of the invention with a metal foil 32, preferably copper, placed above and below the sheets 30. On application of heat and pressure as depicted in FIG. 3, the resin in pre-preg sheets 30 is cured to a **homogeneous, C-stage cured state** to form the composite 34 and the metal foils 32 are firmly bonded to the composite 34" (emphasis added)). Appellants contend that it is physically impossible for a "layer" of resin to exist after the resin has been homogeneously distributed within the fluoropolymer matrix. The Examiner rebuts this point by relying on Johnson, col. 8 lines 1-4 which states: "Microscopic examination of cross sections of the laminated composite showed a uniform distribution of epoxy resin around the fibers, within the interstices of the fabric and between the layers of fabric."

From the preceding discussion, the pertinent issue is whether the "uniform distribution of epoxy resin ... between the layers of fabric" recited in Johnson, col. 8 lines 1-4 represents "a remaining layer of resin ... disposed on opposite sides of the resin-impregnated fluoropolymer matrix following the laminating step". Appellants maintain that no such alleged remaining layer of resin exists after the C-staged curing. Definitionally, a layer must have thickness.[1] Appellants

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[1] The New Lexicon Webster's Dictionary of the English language 561 (1988 ed.) ("one thickness, coating, etc. of one or more substances lying upon or under one or more other substances"); Webster's New Collegiate Dictionary 477 (2d ed. 1958) ("one thickness, coarse, or fold laid over or under another")

maintain that there is essentially no thickness existing between the layers of fluoropolymer fabric following the C-staged curing, as indicated in Johnson, col. 7, line 64 - col. 8, line 1: "The laminated composite was fully cured to the C-stage state, was approximately 0.45 inches thick and exhibited excellent resin wetting throughout the composite. There was no evidence of air entrapment, blistering, resin voids or delamination between the layers of fabric."

However, the Examiner has cited Johnson, col. 8 lines 1-4 as disclosing a "uniform distribution of epoxy resin around the fibers ... between the layers of fabric" (emphasis added). Appellants maintain that the key to interpreting said "uniform distribution of epoxy resin ... between the layers of fabric" is to recognize that the phrase "uniform distribution" is consistent with a "homogeneous, C-stage cured state" recited in Johnson, col. 6, lines 47-52, cited *supra* by Appellants. Said "uniform distribution" exists "around the fibers" not only between the fluoropolymer fabric layers but also exists "around the fibers" within any cross-section of any fluoropolymer fabric layer as a consequence of the homogeneous distribution of resin "around the fibers" generated by the C-staged curing. Thus, the "uniform distribution of epoxy resin around the fibers" disclosed in Johnson, col. 8 lines 1-4 is not a layer but is instead a plane of homogeneously distributed resin "around the fibers" that is no different than any other plane of homogeneously distributed resin "around the fibers" in any other cross-section within any fluoropolymer fabric layer following the C-staged curing.

Based on the preceding arguments, Applicants respectfully maintain that Johnson does not anticipate claim 23, and that claim 23 is in condition for allowance. Accordingly, Appellants respectfully request reversal of the rejection of claim 23 under 35 U.S.C. §102(b).

Claim 35

Appellants maintain that Johnson does not disclose the following feature of claim 35: "wherein the thermosetting resin includes solvent". In the Examiner's Answer, the Examiner admits: "It is further noted Johnson does not specifically recite a solvent included in the thermosetting resin." In the Examiner's Answer, the Examiner alleges that "However, the resin would inherently include a solvent in view of the following: (1) Johnson teaches the thermosetting resin is applied as liquid, i.e. the resin is not applied as a melt and (2) After coating the dielectric material with the liquid thermosetting resin Johnson teaches the coated-dielectric is dried such that if the resin were applied in a melt form there would be no need to dry the coated dielectric."

In response, Appellants first contend that Johnson does not teach that "the coated-dielectric is dried such that if the resin were applied in a melt form there would be no need to dry the coated dielectric" as alleged by the Examiner. The Examiner has not supplied a citation in Johnson to demonstrate that Johnson discloses the alleged teaching, and Appellants maintain that no such teaching exists in Johnson.

Moreover, Appellants contend that the fact that the thermosetting resin is applied as liquid does not imply that "the thermosetting resin includes solvent" as required by claim 35 for the following reason. First, Appellants cite col. 4, lines 49-55 of Johnson: "However, treated fluorocarbon fabric can be impregnated with a liquid thermosetting resin and partially cured to a dry, flexible sheet of B-stage pre-preg. One or more of the B-stage pre-preg sheets can be stacked together to a desired thickness and laminated under heat and pressure to form a laminated composite of thermosetting resin and fluorocarbon fabric."

Hence, Johnson teaches that the conversion of the fluorocarbon fabric impregnated with liquid thermosetting resin to the dry B-stage pre-peg is effectuated though a curing process, namely B-stage curing. However, a curing process is a chemical process that chemically changes the resin being cured by converting the resin being cured from a low-molecular resin to a cross-linked substance. Said chemical change can effectuate said drying regardless of whether or not the resin includes solvent. In other words, since B-stage curing involves application of heat, the Examiner has argued that the only way that the cured resin could be dry is by having the uncured resin include solvent, and vaporization of the solvent during the B-stage curing would leave the cured resin in a dry state. Applicant acknowledge that although the preceding argument by the Examiner presents a possibility, the dry state of the cured resin could also be achieved through the curing process itself which produces a dry, cross-linked material of higher molecular mass, regardless of whether or not the resin includes solvent. Thus, Appellants contend that it is not inherent for the thermosetting resin to include solvent as argued by the Examiner.

To shed more light on the curing process in relation to cross-linking, Appellants first cite the website "http://composite.miningco.com/library/glossary/c/bldef-c1411.htm" for the following definition of curing: "The overall transformation from a low molecular weight resin/hardener system to a cross-linked network by chemical reaction."

Appellants additionally cite Paragraph [0007] of U.S. Patent Application 2003/0118835 (Jayaraman, Saikumar et al.; June 26, 2003) for a more complete discussion of curing in relation to cross-linking: "In general an underfill material, when cured, is a composite material made up of cross-linked resin. Generally, cross-linking is the attachment of two polymer chains by bridges of an element, a molecular group, or a compound, and in general will occur upon heating.

Polymers can be prepared at a variety of cross-link density–from tacky, elastomeric to tough, glassy--by the judicious choice and amount of mono- or polyfunctional compounds, resins, and crosslinking agents. The greater proportion of polyfunctional compounds reacted, the greater the cross-link density" (emphasis added). Appellants further cite the following two references to demonstrate the association of curing with cross-linking: U.S. Patent Application 2002/0060360 (Jiang; May 23, 2002) Paragraph [0023] ("To completely cure a resin; i.e., to filly cross-link the resin ..."); and U.S. Patent 6,100356 (Frenkel et al.; August 8, 2000) col. 1, line 31 ("to cure or cross-link various resins").

In addition, Appellants contend that if Johnson had intended that the thermosetting resin include solvent, then Johnson would have stated that the thermosetting resin includes solvent. The absence of any such statement in Johnson makes it a requirement that the Examiner prove the alleged inherency, which the Examiner has not done.

Based on the preceding arguments, Applicants respectfully maintain that Johnson does not anticipate claim 35, and that claim 35 is in condition for allowance. Accordingly, Appellants respectfully request reversal of the rejection of claim 35 under 35 U.S.C. §102(b).

Claim 43

Appellants emphasize that the Examiner has not made even a single argument in the Office Action mailed February 4, 2003 or in the Examiner's Answer to show that Johnson teaches the following feature of claim 43: "wherein the fluoropolymer matrix is impregnated with the thermosetting resin, **prior to the providing step**" (emphasis added).

Accordingly, Appellants contend that claim 43 is not anticipated by Johnson, and the

rejection of claim 43 under 35 U.S.C. §102(b) should accordingly be reversed.

Issue 4

CLAIM 37 UNDER 35 U.S.C. §103(A) IS NOT UNPATENTABLE OVER JOHNSON, AND FURTHER IN VIEW OF UENO ET AL. (U.S. PATENT 4,765,860) AND KUSANO ET AL. (U.S. PATENT 5,425,832).

The Examiner rejected claim 37 under 35 U.S.C. §103(a) as allegedly unpatentable over Johnson, and further in view of Ueno et al. (U.S. Patent 4,765,860) and Kusano et al. (U.S. Patent 5,425,832).

Appellants maintain that, Johnson in view of Ueno or Kusano does not disclose the following feature of claim 37: "further comprising the step of subjecting the fluoropolymer matrix to a plasma process, prior to the coating step".

In the Examiner's Answer, the Examiner admits that Johnson does not teach "... subjecting the PTFE matrix to a plasma process prior to coating." However, the Examiner alleges: "It is well known in the art when bonding a PTFE matrix to a conductive material to first subject the PTFE matrix to a plasma process to provide the PTFE matrix with a hydrophilic surface thereby enhancing adhesion between the PTFE matrix and the conductor as shown for example by Ueno et al. and Kusano et al. One of ordinary skill in the art at the time the invention was made reading Johnson in view of Ueno et al. and Kusano et al. would have readily appreciated modifying the method taught by Johnson to incorporate the well known plasma discharge technique shown for example by Ueno et al. and Kusano et al. to provide the PTFE matrix with a hydrophilic surface thus enhancing the adhesion between the PTFE matrix and the conductor."

In response to the preceding argument by the Examiner, Appellants contend that the Examiner's argument for modifying Johnson with said plasma process prior to coating with a resin is not persuasive, because Johnson does not teach or suggest that Johnson's method for bonding the conductor to the PTFE matrix is inadequate. Thus, Appellants contend that it is not obvious to subject the PTFE matrix of Johnson to a plasma process prior to coating, as required by claim 37, because to do so would add unnecessary time and expense.

Based on the preceding arguments, Applicants maintain that claim 37 is not unpatentable under 35 U.S.C. §103(a), and the rejection of claim 37 should accordingly be reversed

Issue 5

CLAIMS 31, 39, AND 49 UNDER 35 U.S.C. §103(A) ARE NOT UNPATENTABLE OVER JOHNSON AND FURTHER IN VIEW OF KODOKIAN (U.S. PATENT 5,762,741).

The Examiner rejected claim 31, 39, and 49 under 35 U.S.C. §103(a) as allegedly unpatentable over Johnson and further in view of Kodokian (U.S. Patent 5,762,741).

Claim 39

Appellants contend that Johnson in view of Kodokian does not disclose the following feature of claim 39: "wherein the thermosetting resin contains about 30-75 percent solids".

In the Examiner's Answer, the Examiner admits that Johnson does not teach a thermosetting resin includes 30-75 percent solids. However in the Examiner's Answer, the Examiner alleges: "One of ordinary skill in the art at the time the invention was made reading Johnson in view of Kodokian would have readily understood using a thermosetting resin in the

method taught by Johnson that includes filler materials as suggested by Kodokian as only the expected results, would be achieved. As to the amount of filler material, i.e. the percent solids, one of ordinary skill in the art at the time the invention was made would have readily understood that when using a liquid thermosetting resin as taught by Johnson as modified by Kodokian the resin would have included less than 100% solids such that the resin has a range of <100 percent solids and the claimed range of 30-75 percent solids falls in that range."

In response to the preceding argument by the Examiner, Appellants contend that the Examiner's argument for modifying Johnson with inclusion of 30-75 percent solids with the thermoset resin is not persuasive for at least the following reasons. A first reason is that the Examiner has offered no evidence or argument to support the Examiner's allegation that "one of ordinary skill in the art at the time the invention was made would have readily understood that when using a liquid thermosetting resin as taught by Johnson as modified by Kodokian the resin would have included less than 100% solids such that the resin has a range of <100 percent solids" Therefore, the Examiner's conclusory allegation does not satisfy the Examiner's burden to prove a *prima facie* case of obviousness in relation to claim 39. A second reason is that one of ordinary skill in the art at the time the invention was made would not have readily understood that when using liquid thermosetting resin as taught by Johnson the resin would have included no more than 75% solids, as required by claim 39. The Examiner's argument that a range of less than 100% includes the claimed narrower range of 30-75 percent is not persuasive since neither Johnson nor Kodokian teaches or suggests any range of percent solids within the thermosetting resin.

Based on the preceding arguments, Applicants maintain that claim 39 is not unpatentable

under 35 U.S.C. §103(a), and claim 39 should accordingly be reversed.

SUMMARY

In summary, Applicants respectfully request reversal of the rejection of:

claims 23, 25, 29, 32, 35, 36, 40-43, and 45 under 35 U.S.C. §102(b); and

claims 24, 33, 46-48, 37, 39, and 49 under 35 U.S.C. §103(a).

Respectfully submitted,

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